

Alpha Logs and Exponents
2008 National Mu Alpha Theta Convention

1. Which of the following is a condensed form of the following logarithmic expression where $x > 0, y > 0$?

$$\frac{1}{4} \log x^2 - 2 \log y + \log 4$$

- a. $\log \frac{4x}{y}$ c. $\log \frac{4\sqrt{x}}{y^2}$ e. None of the Above
- b. $\log \frac{4x^2}{y^2}$ d. $\log(\sqrt{x} - y^2 + 4)$

2. Solve for x: $\frac{e^x}{e^x - 1} = 5$

- a. $\ln \frac{5}{4}$ c. $\ln \frac{1}{4}$ e. None of the Above
- b. $\ln \frac{4}{5}$ d. $\ln \frac{-1}{4}$

3. The temperature T of a loaf of bread t minutes after being removed from the oven can be modeled by the equation $T = T_R + 5e^{\ln(\frac{3}{8}t)}$, where T_R is the room temperature. Determine how many minutes it will take a loaf of bread to cool down to 90°F at a room temperature of 75°F.

- a. 5 min c. 10 min e. None of the Above
- b. 8 min d. 16 min

4. A sum of money is invested in the Mullionaire's Club Bank at 10% compounded continuously. Determine after how many years there will be a 150% increase in the original investment.

- a. $(0.1)\ln 1.5$ years c. $\ln 15$ years e. None of the Above
- b. $10\ln 1.5$ years d. 1.5 years

5. If x and y are both distinct positive integers, solve for the smallest possible value for x + y given: $9^x = (x^y)(9^y)$

- a. 0 c. 5 e. None of the Above
- b. 3 d. 7

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6. Which of the following is an expanded form of the following logarithmic expression where $x > 0, y > 0$?

$$\log_b \sqrt[3]{4x^5y^7}$$

- a. $\frac{1}{3}[\log_b 4 + 5 \log_b x + 7 \log_b y]$
 - b. $-\frac{1}{3}[\log_b 4 + 5 \log_b x + 7 \log_b y]$
 - c. $3[4 \log_b + 5 \log_b x + 7 \log_b y]$
 - d. $\frac{1}{3}[4 \log_b + 5 \log_b x + 7 \log_b y]$
 - e. None of the Above
7. Determine the characteristic and mantissa: $\log = 2.6385$.
- a. *characteristic = 6385, mantissa = 2*
 - b. *characteristic = -8, mantissa = -0.6385*
 - c. *characteristic = 2, mantissa = 0.6385*
 - d. *characteristic = 8, mantissa = 0.6385*
 - e. None of the Above
8. A culture of 5 bacteria has grown exponentially to 20 bacteria in 4 hours. Determine the number of bacteria after 24 hours for this culture.
- a. 4096
 - b. 20,480
 - c. 81,920
 - d. 240,576
 - e. None of the Above
9. Which of the following exponential equations represents an exponential decay?
- a. $y = 2e^{0.21t}$
 - b. $y = 2e^{-0.21t}$
 - c. $y = 5(2)^t$
 - d. $y = 4 - 4(2)^{-t}$
 - e. None of the Above
10. Find the vertical asymptote of the logarithmic equation: $f(x) = -\log_3(x+2) - 4$.
- a. $x = -2$
 - b. $x = 2$
 - c. $x = -4$
 - d. $x = 0$
 - e. None of the Above

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11. Ivana Calculate wants to invest her 2008 Tax Refund Check from the IRS. She worked really hard this year and is being reimbursed \$2,000 from the Federal Government. She is not sure how to maximize her earnings. Which of the following plans would earn her the most interest after 10 years?

- | | | |
|--------------------------|-------------------------|-------------------------|
| a. Continuously,
r=5% | c. Biannually,
r=10% | e. None of the
Above |
| b. Quarterly,
r=5% | d. Monthly,
r=10% | |

12. General Mutors Company has a new car coming out with the given expected depreciation function: $G(t)$ is the car value in dollars at time t in years:

$$G(t) = \frac{300,000t^2(t^2 - 1)}{1 - 10,000t^2 + 1,000t^4}$$

Find $\lim_{t \rightarrow \infty} G(t)$.

- | | | |
|---------|-----------|-------------------------|
| a. \$0 | c. \$300 | e. None of
the Above |
| b. \$30 | d. \$3000 | |

13. Simplify to one expression with positive exponents:

$$\left[\frac{8!(uv)^{-8} \frac{u^{-80}}{v^{2008}}}{-(4!)uv^{-20} (\ln e^{v^u})} \right]^{-2}$$

- | | |
|---|--|
| a. $\frac{-u^{89} v^{1996+u}}{1680}$ | |
| b. $\frac{u^{178} v^{3992+2u}}{1680^2}$ | |
| c. $-2u^{178} v^2$ | |
| d. $1680u^{89} v^{1996+u}$ | |
| e. None of the Above | |

14. Simplify when $n \neq 1$: $\left(\frac{(n-1)^{-2}}{(n^2-1)^{-3}} \right)^{\text{Arccos}(1)}$

- | | |
|---|--|
| a. $\left(\frac{(n+1)^{3\pi}}{(n-1)^{2\pi}} \right)$ | |
| b. $\left(\frac{(n+1)^{3\pi-1}}{(n-1)^{2\pi-1}} \right)$ | |
| c. $\frac{(n^2-1)^2(n+1)}{(n-1)}$ | |
| d. $(n^2-1)(n+1)^2$ | |
| e. None of the Above | |

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15. Simplify: $\frac{(\log 243)(\log 625)(\log 216)}{(\log 36)(\log 729)(\log 25)}$

a. $\frac{2}{5}$
b. $\frac{5}{2}$

c. 3
d. 100

e. None of the Above

16. Simplify: $3^{-x}(9^{2x^2}(27^{-7x}(243^{\frac{2}{5}})))$

a. 3^{-2008x}
b. 3

c. 5
d. $3^{4x^2-22x-2}$

e. None of the Above

17. Which of the numbers listed below is the largest?

a. 2^{2008}
b. 3^{1004}

c. $\frac{1}{8}^{-502}$
d. $\frac{1}{9}^{-251}$

e. None of the Above

18. Find x if $\ln e^{2\cos^2 x - 1} = \cos x$, for $0 < x \leq \pi$.

a. 0
b. $\frac{\pi}{6}$

c. $\frac{5\pi}{6}$
d. $-\frac{\pi}{6}$

e. None of the Above

19. If $64^{-x} = 1024$, then find x .

a. $\frac{-5}{3}$
b. $\frac{-2}{3}$

c. $\frac{3}{5}$
d. $\frac{-5}{6}$

e. None of the Above

20. Find the product of the solutions of the equation: $8^{4x^2+43x-62} = 64$

a. $\frac{-43}{4}$
b. 4

c. -16
d. $\frac{43}{4}$

e. None of the Above

21. $(1-i)^{24} = ?$

a. 2^4
b. 2^{12}

c. $2^{12} + i$
d. $2^{12}i$

e. None of the Above

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22. Find the coefficient of the x^3y^5 term of $(2x - y)^8$.

- a. -8
b. 8
c. 2688
d. 448
e. None of the Above

23. Solve for x : $\log(\sin^2 x) + \log(\sec^2 x) - \log(1 + \tan^2 x) = 0, 0 \leq x \leq 2\pi$.

- a. $x = \frac{\pi}{2}$
b. $x = \frac{\pi}{2}, \frac{3\pi}{2}$
c. $x = \pm \frac{\pi}{2}$
d. $x = 0$
e. None of the Above

24. Choose an answer that is a simplified form of the following expression: $e^{\frac{\pi i}{4}}$.

- a. $\frac{\sqrt{2}}{2} - \frac{\sqrt{2}}{2}i$
b. $e^{-\frac{1}{4}}$
c. $\frac{\sqrt{2}}{2} + \frac{\sqrt{2}}{2}i$
d. $e^{\frac{1}{4}}$
e. None of the Above

25. $(-\frac{i}{2})^{2008} =$

- a. 2^{-2008}
b. -2^{2008}
c. $2i^{2008}$
d. $\frac{1}{2^{-2008}}$
e. None of the Above

26. Solve the equation for x : $6^x(6^{2x}) = 54$

- a. $\frac{3 \log 54}{\log 6}$
b. $\frac{\log 54}{3 \log 6}$
c. $\frac{1}{3} \log_{54} 6$
d. $-3 \frac{\log 54}{\log 6}$
e. None of the Above

27. Find the sum of the roots of: $x^{\frac{4}{3}} - 91x^{\frac{2}{3}} + 1728 = 0$

- a. $3\sqrt{3} + 512$
b. $81\sqrt{3} + 512$
c. 7
d. 25
e. None of the Above

28. Find the domain of: $y = \log(16x^3 - 8x^2 + 30x - 15)$

- a. $\left(\frac{-15}{8}, \frac{1}{2}\right)$
- b. $\left[\frac{-15}{8}, \frac{1}{2}\right] \cup \left[\frac{15}{8}, \infty\right)$
- c. $\left(\frac{-15}{8}, \infty\right)$
- d. $\left(\frac{1}{2}, \infty\right)$
- e. None of the Above

29. Solve for x if the determinant has a value of 0:
$$\begin{pmatrix} x & e^{(\ln 5)} & e^{(\ln 6 - \ln 6)} \\ e^{(4 \ln 6 - 4 \ln 2)} & 0 & e^{(-\ln 5)} \\ e^{5 \ln e} & 5^{\ln e^2} & e^{\pi i} \end{pmatrix}$$

- a. 0
- b. $486 + \frac{e^5}{5}$
- c. $324 - \frac{e^5}{5}$
- d. e^2
- e. None of the Above

30. $\left[\frac{(x^2 - y^2)^{-3}}{-(x + y)^{-4}}\right]^{\frac{-2}{3}} =$

- a. $\frac{(y - x)^2}{(x + y)^{\frac{2}{3}}}$
- b. $\frac{-(x - y)^3}{(x + y)^2}$
- c. $\frac{(x - y)^2}{(x + y)^{\frac{2}{3}}}$
- d. $\frac{-(x - y)^2}{(y - x)^{\frac{2}{3}}}$
- e. None of the Above